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No. RW/NH-11038/2/87-DOI (Vol. II) *Dated, the 4th April, 1990*

To

The Secretaries (dealing with National Highways), Public Works Departments of all States and Union Territories.

Subject: Updated norms for maintenance of National Highways.

I am to refer to this Ministry's letter of even number dated 25th November, 1988 enclosing therewith norms for maintenance for State roads and other categories of roads prepared by the Study Group and approved by TDC to be projected for grant of funds by the 9th Finance Commission. These norms have now also been made applicable to National Highways. I am, accordingly, enclosing a copy of the report of the Study Group on norms for maintenance of roads including National Highways, for your information and necessary action. These norms will be effective from 1.4.1990. It is, therefore, requested that in future the estimates for maintenance of National Highways may be projected on the basis of these norms.

Copy of letter No. MNR-2387/G0I/147D dated the 4th August 1988 addressed to Director General (Road Development) and Addl. Secretary to the Govt. of India, Ministry of Surface Transport (R.W.) from Chief Engineer R & B and Jt. Secretary, Govt. of Gujarat.

The Study Group, appointed vide letter quoted above on updating norms for maintenance of roads has completed the task and I have a great pleasure in placing the report in your hands.

The report, while recommending updated maintenance norms for State Highways, Major District Roads and other roads, has exhaustively dealt with maintenance needs and practices to produce a balanced minimum programme which it is hoped, will be useful to the highway engineers and to the policy makers. Despite sincere efforts and hard work, submission of report is delayed by a few days which is regretted.

On behalf of the members of the group and on my behalf I wish to express grateful thanks to you for giving such an opportunity to us.

ACKNOWLEDGEMENTS

The work of preparing this report on updating norms for maintenance of roads would not have been possible without continuous help and support from Shri V.P. Kamdar, Secretary, Govt. of Gujarat, Roads & Buildings Department . The Study Group, therefore, wishes to express its gratefulness to him.

Shri D.P. Gupta, Chief Engineer, MOST, New Delhi, provided good guidance to the study group in its first meeting for the scope of work and area to be covered. The group, therefore, while recognising utility of his guidance wishes to express thanks to him.

S/Shri I.C. Shah, Executive Engineer, M.G. Jani, Deputy Executive Engineer, D.N. Parikh, Deputy Executive Engineer. N.M. Patel, Deputy Executive Engineer, G.I. Shah, Deputy Executive Engineer, P.K. Shah, Deputy Executive Engineer (Gujarat Bhavan, New Delhi), Lakhani, Assistant Engineer and Shailesh Shah, Assistant Engineer, all of Gujarat P.W.D. have rendered great help in compiling and typing work to make the report see the light of the day. The Study Group, therefore, sincerely acknowledges their services.

The services of Shri B.V. Patel Superintending Engineer, Rajkot Circle I and Shri M.R. Jani, Superintending Engineer, Rajkot Circle II along with their Executive Engineers and Deputy Executive Engineers who arranged an extensive study tour of the group to see road maintenance practices on site are well appreciated by the Group.

The Study Group will fail in its duties, if the continuous presence in meetings and hard work of the invitees Shri R.D. Patel, Superintending Engineer, Gujarat and Shri P.R. Rao, Executive Engineer, MOST, are not gratefully acknowledged.

The Group, while being extremely happy with the support rendered by several other officers of Gujarat PWD though not named here, wishes to express profound gratitude and thanks to Govt. of Gujarat for supporting this noble cause and sparing the valuable time of its officers to help bringing out this report.

REPORT OF THE STUDY GROUP ON UPDATING NORMS FOR MAINTENANCE OF ROADS (NATIONAL HIGHWAY, STATE HIGHWAY & OTHER CATEGORIES)

1. Preamble

The Standing Committee on Maintenance of Roads appointed by the Ministry of Surface Transport, Government of India, vide their Memorandum No. NH-11038/4/87-NH. III/DI, dated 13.10.1987, had proposed to appoint a Study Group to go quickly into the matters relating to the existing norms for maintenance of roads and update the same for projecting it to the Ninth Finance Commission. Accordingly, the Ministry of Surface Transport, Government of India vide their letter No. NH-11038/2/88-DO.I of May 20, 1988, appointed the Study Group with following composition:

(1) Shri A.J. Trivedi, Chief Engineer (R&B) & Joint Secretary to Govt. of Gujarat, PWD, Gandhinagar. — Chairman

(2) Shri M.V. Patil, Superintending Engineer, Maharashtra PWD Thane P.W.D. Circle, Thane — Member Secretary

(3) Shri I.C. Goel, Superintending Engineer, Office of the Engineer-in-Chief PWD, Himachal Pradesh, Shimla. — Member

(4) Shri K.D. Aggarwal, Superintending Engineer (Projects), U.P. P.W.D. Headquarters, Lucknow. — Member

(5) Shri Gour Chatterjee, Superintending Engineer Office of the E-in-C, P.W.D. West Bengal Calcutta. — Member

(6) Sri Danish, Executive Engineer, Traffic Engineer Cell Andhra Pradesh PWD., Hyderabad. — Member

Shri R.D. Patel, Superintending Engineer, Gujarat and Shri P.R. Rao, Executive Engineer from MOST, New Delhi, attended all meetings as invitees.

The terms of reference set for the Study Group were:

1. Review the existing norms for maintenance of Roads (excluding National Highways)
2. To look into various activities for routine and periodical maintenance.
3. Suggest categorisation into perennial and non-perennial activities.
4. Unit quantity of materials and manpower requirement for various maintenance activities.
5. Suggestions for improved productivity of labours employed in Road Maintenance and.
6. Update the road maintenance norms to project the same to the 9th Finance Commission.

2. Keeping in view the above objectives, the group held detailed discussions in meetings of June 9, and June 22 at Delhi, July 5 to 8 at Ahmedabad and Gandhinagar and on 16 & 17, July, 1988 at Delhi. The list of the members in attendence in these meetings is in the Annexure-I.

3. Committees, groups and reports of the past

The Road maintenance norms were examined in light of the prevailing situations by the following groups and committees in the past:

(a) Technical group appointed in 1968 and headed by Mr. Sinha, Director General of Roads, MOST, for National Highways and State Highways.

(b) Malhotra Committee appointed by MOST in 1977, for norms of maintenance of lower category roads viz: M.D.Rs, O.D.Rs., and V.R.s.

(c) Vohra Committee appointed by MOST in 1981, for reviewing and updating norms of National Highways.

(d) Recommendations of the Eight Finance Commission published in 1984 for norms of maintenance of State Highways and other roads.

(e) A paper published in February 1987 by Planning Commission which was prefaced by Shri Thaper on "Growing Problem of the maintenance of Roads - A critical study". This paper while documenting historical development of Road Sub Sector of Transport Sector in the country also dealt with the road maintenance needs to keep pace with the rapidly/increasing traffic volumes and axle loads which could not be envisaged in the earlier period during which most of the road capital assets were created in the country.

4. Summary of earlier work on norms of M & R

4.1 Sinha Group Report

In this report, the Group had identified the road repair requirement under three main heads: viz: ordinary repairs, periodical renewals, and special repairs including flood damages. While listing in details the different activities involved in maintenance operations, the report arrived at broad conclusions that the average maintenance cost per kilometer would be Rs. 5010 for single lane B.T. road and Rs 6880 per kilometer for two-lane B.T. road. The road network was classified into four geographic zones on the basis of prices of stone chips. In addition, the road network was further divided into three traffic volume zones, namely,

(1) Low traffic (less than 450 CVD)

(2) Medium traffic (450-1500 CVD)

(3) Heavy traffic (more than 1500 CVD)

Maintenance norms arrived at were based on the price level of 1968 and keeping in view the road and traffic conditions then prevailing. The group dealt with M&R norms for N.Hs and S.Hs which were considered to be equal.

4.2 Malhotra Committee Report

Malhotra Committee Report identified maintenance requirements into four heads, namely, (i) Ordinary repairs (2) Periodical repairs (iii) Special repairs and flood damages and (iv) Premiums on Km norms (as shown in brackets) for roads in special locations like (a) High rain fall (Rs. 770) (b) Snow bound (Rs. 300) (c) Desert (Rs.300) (d) Black Cotton Soil (Rs.300) and (e) Urban links (Rs.

2000). The concept of premium for a particular location was quantified on lumpsum basis. The labour gang requirement was assessed at the rate of 0.3, 0.4 and 0.5 labour per km for B.T., WBM and Earthen roads respectively. Zoning of road network on the basis of prevailing prices of stone chips was not done but suggestion was made to put actual prices as obtaining in the area for basic price adopted in the sample rate analysis. Regarding traffic volumes, the report envisaged that 15% additional provision would be required for road carrying more than 450 CVD. 60% increase over maintenance grant of one lane road was suggested for two lane roads. The average maintenance requirement per km was worked out separately for plain and hilly areas. The average cost of M&R per one single lane Km as worked out in this report was as under:

(a) WBM & B.T. roads in plain areas — Rs. 7250/-

(b) WBM & B.T. roads in hilly areas — Rs. 8800/-

(c) Earthen roads in hilly and plains — Rs. 5163/-

This maintenance cost was based on 1977 price level keeping in view the road condition and traffic demands prevailing then. The Committee dealt with the M&R norms for roads other than NHs & SHs.

4.3 Eighth Finance Commission's recommendations

Eighth Finance Commission recommended flat rates for different group of States of the country for State Highways and other roads. The grouping of the States was presumably done on the basis of average climatic and topographical conditions obtaining in the State. The recommended rates were not shown separately for (a) geographic zones based on prices of stone chips (b) Different traffic volumes and (c) Premiums for special locations. While recommending flat rates per km for different categories of roads the VIIIth Finance Commission recommended 20% addition over the flat rates for Establishment and Tools and Plants. The Table I below gives the summary of rates per km recommended for lower-need group of States and higher-need group of States.

Table I

Category	Surface	Rate per km. Lower-need group	Rate per km. Higher need group
S.H.	B.T. Single lane	21,000	26,400
	Two lane	27,000	32,400
M.D.Rs	B.T.	18,000	23,400
O.D.Rs & Others	W.B.M.	10,800	18,000
	Earthen	8,400	10,800

4.4 Planning Commission paper of "Growing problem of maintenance of Roads" published in 1986, based on N.H. practice shows four different zones of prices of stone aggregates and further division of road network was made into three categories of traffic volumes, namely, less than 450, 450 to 1500 and more than 1500 commercial vehicles per day (CVD). The maintenance tables given in this paper being on the basis of information for N.Hs and S. Hs from Ministry of Surface Transport, the Tables of maintenance costs for major District roads, other roads and for surface other than B.T. were not prepared. The summary of M & R costs for low traffic low price and heavy traffic high price zones as given in this paper is in Table II below.

Table II

Type of road	Low traffic low price zones Rs/kms.	Heavy traffic high price zones Rs/kms.	Premium per km			
			Rainfall 1500-3000 mm (15% of average cost of ord. repairs)	Rainfall more than 3000 mm (20% of average cost of ord. repairs)	Hilly area (43% of average cost of ord. repairs)	Desert & black cotton soil area (14% of average cost of ord. repairs.
One lane B.T.	13,840	27,205	1250	1670	3590	1170
Two lane B.T.	17,780	39,290	1250	1670	3590	1170

While the prices of 1985/1986 were used to work out maintenance costs, it was impressed upon in the paper that higher M & R allocations to save the capital assests from breaking down and to meet the traffic demands were necessary. It was observed in this paper that M&R allocations made available to different States do not exceed 60% of even the normative requirements.

5. Approach of the Study Group towards the Task

After careful consideration and close scrutiny of all the earlier work done by several committees and groups in matters pertaining to maintenance and repairs of roads, the Study Group, comprising fairly representative cross section of highway engineers involved in M&R works of roads in the country, deliberated and decided to adopt the following parameters in updating the maintenance norms:

(i) The maintenance norms for State Highways should be separately worked out. This was with a view that State Highway constitute the main arterial network of roads in the country, comparable to primary highway system in the U.S.A.. In addition, some State Highways are potentially future National Highways and that they carry relatively higher volumes of traffic and have higher geometric and pavement standards compared to lower categories.

(ii) The maintenance requirements for Major District Roads should be worked out separately for the reasons that they are a second important category in the network of State roads. These roads also have higher geometric standards relative to other lower category. Some of the MDRs are potentially SHs for future.

(iii) Other roads which may consist of village roads, command area roads and rural roads should be treated under one category for assessment of maintenance requirement because they all have more or less the same geometric Standards and same traffic pattern.

(iv) In case of S.Hs, the pattern of traffic distribution also varies significantly from area to area. It was therefore, considered appropriate that the S.Hs should further be divided into four different traffic volume zones, namely less than 150, 150 to 450, 450 to 1500 and more than 1500 CVD, as shown in Annexure-III. Keeping in view the same rationale for MDRs, three traffic zones namely less than 150, 150 to 450 & more than 450 CVD are made. This should not only help using the money where needed the most but will also help meeting the traffic demands on objective basis. No separate traffic zones were considered necessary for other roads because the variation in traffic volumes on other roads may not be significant.

(v) The fact that costs of M&R of roads are directly related to the cost of procurement of stone chips and stone aggregates (metal) on road side, clear picture would not be possible unless proper provision is made for variation in prices of these basic materials on roads depending on their geographic situations. It was decided to work out M&R costs under six price zones to reflect as correct situations as possible. Accordingly, six price zones, for stone chip prices averaging from Rs. 105/cm to Rs. 300/cmt; hand broken stone metral prices varying from Rs. 60/cmt to Rs. 230/cmt; and also for varying sand & labour prices, are proposed as detailed in Annexure II to reflect all-encompassing price situation comprehensively. Notwithstanding the concept of price zones, every PWD division, in fact would be detailed estimates on the basis of actual procurement prices to assess the real M&R requirements as per the parameters suggested. Further, the task of making detailed cost estimates for every single road has been made easy by typical rate analysis furnished in the Annexure-VI-A to VI-F for different treatments. The relevance of price-zone is, therefore, limited to general overall assessment of M&R costs for the State as a whole in absence of exhaustive work of detailed analytically arrived costs for M&R to roads for each PWD division in the State.

(vi) The wages of labours vary from place to place. At some places, the wages as per the minimum wages act of even less may be paid whereas at some places the wages may be on the pattern of Class IV servants on regular establishments. Labour disputes and court cases do take place within the same State from time to time for increase in wages of daily related labours working on muster roll. Several labour court and civil court judgements are also on records for labour wages. In one Supreme Court judgement, it has been directed that there should be no discrimination in wages. The principle of equal work equal pay should be followed. It was the feeling of the group that time is not too far that all daily rated muster roll labours working on roads shall have to be paid uniformly. The practice of making daily rated labours as works charged labours has also been followed in some States and the regular pay scales are being given. In context of this background, the Group felt that it would be appropriate to adopt average rate of Rs. 1100/- p.m. per labour to work out unit cost of labour for M&R works which area of a regular and permanent nature. The figures worked out in Annexure-IV A, V A and at other relevant places are on this basis.

(vii) The norms of hiring labours on roads also vary from place to place within the State and from State to State. Historically, the area of employing labours more or less full within the domain of lower level employees. This has not only resulted in serious imbalance in labour requirement vis-s-vis the actual labours but also has given rise to labour disputes. The further continuation of this trend would result in large chunk of limited M&R grants spent on labour payment on the one hand and further deterioration of roads on the other hand because of unproductive expenditure on labours. The Study Group, after exhaustive analysis of M&R works being done through regular departmental labours, came to conclusion that the labour requirement as shown in the Table III below would be adequate for routine M&R works.

For North Eastern regions the figures given in the brackets are applicable. This is because the terrain as well as climatic conditions in the North Eastern States differs very much from other States of the country.

Table III

Category of Road	Type of surface & labour requirement per km	
	B.T./W.B.M.	Earthen
SH, MDR (Irrespective of single lane or two lane)	0.3	Casual labour as per the volume work
Others Roads	0.2	

(viii) The renewal treatment of surface dressing, in the opinion of the Group, is useful only if it is done in a manner intended i.e. complete cleaning of the existing W.B.M. or B.T. surface, brooming the W.B.M. surface including opening out the intervices between the aggregates to about half-inch depth, spreading the bitumen uniformly on entire surface at proper temperature, spreading the clean stone chips of proper gradation uniformly and rolling brooming and re-rolling the surface to ensure that no loose chips remain on pavement and blow off under tyre pressure of speeding vehicles. The Study Group, therefore, strongly recommends that proper methodology, with suitable equipments be followed in practice so as to derive maximum benefit out of surface dressing treatment. However, in certain States, surface dressing is being gradually replaced with mix seal surfacing (MSS) treatment because it is recognised to be a better minimum treatment roughly at the same cost of surface dressing.

(ix) The two-lane roads show relatively low deterioration compared to one-lane roads because of larger pavement area for travel of vehicles. The area of patches though may be less in 100 smt area of two-lane roads, the overall patch are for one-lane and two-lane roads would more or less be the same. While there would be relatively little work on broken edges and depressions in side shoulders in two-lane roads compared to one-lane, the central line marking would be an additional work required for two-lane roads. The cost of ordinary repairs would therefore, remain more or less the same both for two lane and one-lane roads. Renewal costs of one km. of two lane roads (7.0 M vide) would be about 95% more than the one-lane road. Keeping in view these factors and also the assessment made in earlier studies, the group decided that the total M&R grants required for two-lane roads would be 60% more than one-lane roads. Likewise, for intermediate lanes (5.5 mtr), the M & R grants would be 30% more than one-lane road. The maintenance costs for two-lane or intermediate lane roads could, therefore, be worked out from detailed one-lane norms given in Annexure-IV & V (A to F) by adding 60% more on the amount shown in row 5 for total of M & R including F.D.

(x) The roads in hilly areas are generally made with relatively harder material compared to ordinary soils of plain areas. Certain hill roads are built with locally available hard material on the top duly watered and rolled. Such roads, where top surface layer has been prepared after necessary watering, rolling and cambering of the locally available hard material, are comparable to W.B.M. roads of plains. The renewal of such roads should preferably be done by a layer of graded aggregates in order to convert them into regular W.B.M. roads rather than spreading earth and keeping them in the same shape indefinetely. The group therefore decided that M & R norms for such roads be kept at the level of W.B.M. surface rather than under the earthen roads. Other hilly roads which are not built to a condition to readily receive a layer of W.B.M. as a renewal coat may continue as earthen roads for M & R grants till such time they are improved from the available M & R grants to receive a layer of W.B.M.

6. Activities Involved in Maintenance & Repairs (M & R) of Roads

With a view that the roads, which have proved to be of vital infrastructure in making rapid socio-economic development of the Area/Region/ State/Country, should be kept in trafficable condition acceptable to ever increasing public awareness of riding quality and safety. Continuous M & R operations, as for any other assets either public or private, need to be performed by the highway authorities. M & R operations of roads can be scientifically divided on the basis of nature of work, into four major exclusive activities, namely, (1) Ordinary repairs (2) Periodical Renewals (3) Special repairs and (4) Flood damage repairs. Brief description of work to be performed under each major activity follows:

6.1 **Ordinary Repairs:** The vital aspect of this activity is that it goes on all the year round and is handled departmentally by regular labours employed on a continuous basis. Procurement of materials required on site when and where necessary is also generally on annual contract basis. The works to be carried out comprise (a) Filling up the B.T. or W.B.M. pavement side widths and dressing the shoulders and slopes to proper camber and line to help drain water and facilitate passing and crossing movements of vehicles (b) patches and pot holes developed in pavement due to climatic conditions and continuous traffic loads have to be filled up and levelled with existing wearing surface by using mixed materials (c) Attendance to road side drainage, cross drainage, works and retaining structures (d) Lopping of overhanging branches, removal of dead and fallen trees and maintaining shurbs or grass in medians (e) Maintaining road side facilities, store sheds and godowns (f) repainting, refixing, shifting etc. of sign boards, KM, Hectometer, guard and indicator stones and (g) Routine maintenance of S.P.T. Bridges in North Eastern States etc.

Keeping in view the magnitude of each of this routinal work, the annual monetary requirement per kilometer is worked and shown in Annexure-IV-A to IV-F for State Highways (SHS) and in Annexure-V-A to V-F for Major District Road (MDR) and other roads under the title ordinary repairs.

6.2 **Periodical Renewals:** The top surface of any road is directly subjected to continuous traffic loads and is the first member of the road structure bearing the burden of wear and tear. It is this top surface, known as Wearing Surface, that needs renewal at certain time intervals depending upon the burden it bears under varying climatic and sub-grade soil conditions. Timely preventive renewal serves the purpose of "Stitch in Time Saves Nine". Failure to keep track of timely renewal requirement brings about a situation of expensive rebuilding of the crust, considerable inconvenience to traffic and heavy vehicle operating costs to ever increasing road conscious traffic and general public. The need for regular periodical renewals, therefore, deserves utmost importance. While there is dire need for regular periodical renewals of roads, the constraints of resources call for a prudent balance between the needs and the resources. The Study Group, therefore, deliberated in depth on this complex issue to assess the renewal needs and costs such that maximum can be achieved at a minimum price and decided to adopt following renewal treatments, briefly discussed:

(a) **Mix Seal Surface:** The treatment consists of laying 0.18 cmt (6 cft) of bitumen mixed stone chips (mixed at about 5% weight of mix) of 4.75 mm to 10 mm size on 10 smt (about 100 sft) on existing B.T. road surface at appropriate temperature duly compacted by power rollers. Tack coat of 5 kg. on existing B.T. surface and 10 kg. on W.B.M. surface per 10 smt area would be necessary. This is the minimum conceivable and possible renewal treatment which can be adopted successfully for low traffic density SHs and other roads. The treatment is capable to replace without significant extra cost surface dressing treatment which has inherent inadequacy in execution under Indian conditions. The details as to on which roads and under what traffic volumes this treatment is proposed are given Annexure-IV-A to IV-F and V-A to V-F.

(b) **Premixed Carpet (PC) (Conventionally laid)**

Generally PC treatment is either immediately or simultaneous followed by a layer of seal coat and the whole treatment, many times, is named as P.C. The layer of seal coat is considered necessary to seal the openness of carpet to make the surface watertight. The group, from experience, observed that a layer of seal coat is peeled off and number of pot holes develop in course of time, particularly during rains because there is no effective interlocking or bond between the two B.T. layers, While the two layer treatment is relatively expensive, it does not give desired results, much less the question of public criticism in cases of failures.

Keeping in view the factors explained in the forgoing para, the study group decided to suggest P.C. treatment of one time laid one layer. The suggested treatment consists of laying 0.27 cmt. (9 cft) stone chips (50% 4.75 to 6 mm size and 50% 10 mm to 12 mm size) mixed with 4% bitumen at proper temperature and compacted by power roller and flushed with minimum required stone dust or coarse sand. The tact coat requirement will be same as for MSS. This renewal treatment may be followed on S.Hs. and MDRs where Hot-mix and paver facility is unlikely to be available and has to be done manually in a conventional manner. The treatment, while being economical, would give better results insteads of two seperate layer treatment namely, carpet & seal coat. The details as to where and when this treatment may be adopted are given in Annexure-V-A to V-F with detailed rate analysis of the item in Annexure-VI-B. If need be this treatment consisting of one composite layer may be increased to 25 mm thickness.

(c) **20 mm Semi Dense-Carpet - Paver Laid**

This renewal treatment consists of laying with paver 0.27 cm, materials duly mixed with 5% bitumen (by weight of mix) in hot-mix plant at a proper temperature and compacted with power rollers. In order that mix is dense, mix design needs to be done to arrive at proportions of aggregates and fines. In absence of laboratory design, mixing of 30% fines (sand or stone dust), 35% stone chips of 4.75 mm to 6 mm size and 35% stone chips of 10 mm to 12 mm size would produce satisfactory semi dense mix. Tack coat of 5 kg. on existing B.T. and 10 kg. on W.B.M. surface for 10 smt area would be necessary

The treatment is being used extensively in Gujarat and has produced satisfactory results. Wherever facilities of hot-mix plants and pavers are available, either through departmental procurement or through contracting agencies, most of the renewal needs of heavily trafficked routes can be efficiently handled by this treatment. The Study Group recommends the extensive use of this treatment on S.Hs or MDRs carrying higher traffic volumes. If need be, thickness be increased to 25 mm for high traffic density corridors. The Annexure-IV-A to F gives details about when and where this treatment is proposed and the typical rate analysis is in Annexure-VI-A.

(d) **Liquid Sand Seal Coat**

No highway engineer would like to see helplessly the wearing surface cracking and disintegrating because of non availability of adequate funds to lay a regular renewal layer. With a view to save, for some time, wearing surface showing signs of cracking and disintegration relatively cheaper treatment of liquid sand seal coat would prove very useful. The treatment consists of applying a uniform coat of hot bitumen 14 to 16 kg/10 smt. (at proper temperature) and uniformly flushing coarse

sand at a rate of .09 cmt. and rolling brooming and re-rolling. The treatment may be warranted in selected areas of the wearing surface to help contain, for some more time, cracking and disintegrating. Areas needing this treatment, however, would need to be identified by close visual supervisions at sufficiently early stages. Study Group recommends introduction of this relief-type work under periodical repairs as shown in Annexure-IV-A to F and V-A to F, with typical rate analysis in Annexure-VI-F.

(e) **W.B.M. Renewals**

The existing Water Bound Macadam (W.B.M.) roads are maintained by spreading blindage materials on the top so that dislocation of metal pieces could be prevented to the extent possible. However under, constant pneumatic tyre pressures (causing sucking effects of motor vehicles, there is inevitable effect of dislocation of stone aggregates form the pavement resulting in formation of pot holes and undulations. The W.B.M. surface disintegrates during rains when blindage is washed off and binding material gets softened. The W.B.M. surface, therefore, cannot remain in tact for long under traffic loads in such varying climatic conditions and therefore renewal layers to resection the surface and to restore the lost materials are required at certain time intervals to keep the roads trafficable.

The Study Group after detailed discussion came to the conclusion that as a minimum renewal measure; W.B.M. renewal layer of compacted 75 mm thick (MR) is essential to maintain the traffic worthiness of existing WBM roads. The details as to when and where these treatments are proposed are shown in Annexure-IV A to F and VA to VF. The typical rate analysis is in Annexure-VI-D.

6.2.1 Life cycles of periodical renewals

Several factors arising from varying climatic, soil, topographical and traffic load conditions tend to decide the length of life cycles of different renewal treatments explained in para 6.2. Attempt to evaluate each factor to determine definite time of life cycle for each type of renewal treatment may be of academic interest but real situations in the field call for renewal either earlier or later. It is from experience and earlier reports on the issue that the life cycles, in the opinion of the group, as suggested in the Table IV below would be most practical and fairly representatives of real world.

Table IV

Life cycles in years for different renewal treatments

A-State Highways:

Type of Treatment	B.T.				W.B.M.		
	Less than 150 CVD	150 to 450 CVD	450 to 1500 CVD	Over 1500 CVD	Upto 450 CVD	450 to 1500 CVD	Over 1500 CVD
MSS Cycle	6	5	–	–	–	–	–
SDC Cycle	–	–	5	4	–	–	–
MR Cycle	–	–	–	–	5	4	3

B - Major District and Other Roads

Type of Treatment	B.T.			W.B.M.		ODRs/Vrs	
	Less than 150 CVD	150 to 450 CVD	Over 450 CVD	Upto 450 CVD	Over 450 CVD	B.T.	W.B.M.
MSS Cycle	6	5	–	–	–	6	–
PC Cycle	–	–	5	–	–	–	–
MR Cycle	–	–	–	5	4	–	–
MR-1 Cycle	–	–	–	–	–	–	5

The renewal cycle lengths as shown in Table IV above are used in Annexure-IV-A to F and V-A to F to work out costs for periodical renewals. The cycle length of L.S.S. treatment was based on the consideration that average 10% area on heavily trafficked routes and 8% area on low traffic roads would require this preventive treatment every year in addition to regular periodical renewal work carried out as per life cycles on B.T. roads.

6.3 Special Repairs

Under this component of M & R works of roads, works of special nature need to be attended. These works comprise.

(a) guniting/grouting to weak bridges and culverts.

(b) widening narrow culverts and rebuilding weak and damaged culverts.

(c) reconstructing retaining and breast walls.

(d) building parking areas and additional paved lengths.

(e) road widening works in some selected lengths.

(f) repairs to Semi Permanent Timper (S.P.T.) Bridges in North Eastern States, and

(g) protection of bridges.

The works being neither of ordinary nor periodic nature and that they may not be required to be carried out on all roads, they have been termed as special repairs. It is also difficult to arrive at costs on km. basis and therefore lumpsum provision is suggested keeping

in view the traffic densities on roads as shown in Annexure-IV-A to F and VA to F. The amount of S.R. may be used where necessary.

6.4 **Flood Damage Repairs**

While recognising the fact that all roads may not be damaged simultaneously by natural calamities like floods, cyclones, snow storms or could bursts; it is to be truly admitted that almost every State is faced with one or the other natural calamity in one part or the other almost every year. The damages caused to road assets by such natural calamities cannot be anticipated. It will, therefore, be appropriate to set apart certain lumpsum amount every year to meet the needs sprung from such exigencies so that needy areas do not suffer for long for want of funds. The Study Group after careful consideration of all possible eventualities arising from calamities decided to provide a lumpsum amount of 12½% of all M & R costs for F.D. as shown in Annexes. In fact, the funds would be necessary and be allotted as per the actual damages.

7. **Perennial & Non-perinnial Activities**

For M & R works of roads, there are certain works which require to be done almost every day round the year on each road. These works are generally handled through regular labour gangs and departmental supply of materials. These perennial works include filling the edges and side width of pavement, spreading blindage over W.B.M. roads, removing jungle, shurbs and debris from the road way, watering shurbs and cutting grass from medians etc. It is on the basis of workload of perennial activities that the size of the regular labour strength required can be determined for each single road. Other activities of M & R would be of non-perennial nature and are generally performed through contract at certain intervals time. In the broader sense of the term of perennial works other than F.D. from a regular activity to be called as periodical.

8. **Improved Productivity of Labours**

In all types of road works including M & R, the labour component is significant. The items like ordinary repairs, earth work, pot hole filling in W.B.M. roads, looping of tree branches, guard stone painting, picking of loose metals, removal of accidents are of labour insentive nature. For all M & R work in general and for the items of ordinary repairs in particular the quality and quantity produced by labours largely depend on productivity of departmental labours. Likewise the quality of works carried out through contracts also reflect productivity of labours. It is more or less the productivity know-how of labours which mainly affect the standards of roads in this country. Importantly, gainful employment to illiterate, landless and rural poor being a national social objective the works on highways and roads having a good potential for labour employment can help to meet the objective. Consistent with this social objective, whatever can be done efficiently through labours need not be switched over to machines has been the general policy of highway engineers in the country. The area of improving the productivity of labours, therefore, assumes all the more importance to meet social obligations on the one hand and to improve the quality of roads on the other hand. In this context the study group felt that the following measures would prove useful.

(a) The labour engaged by department should be paid wages and other benefits regularly and as per rules and without any discrimination. The service conditions of labours should be so made as to be conducive to security and accountability in the job.

(b) The labour recruitment procedure should be streamlined and be made capable to generate sense of competitiveness for a slot of employment and that work may be lost for poor performance. The elements like time consumed, fatigue caused and need for housing relocations by labours in reporting to work may also be kept in view while selecting the geographic areas for recruitment.

(c) The tools and equipments necessary for work should be made easily available and their usage properly demonstrated.

(d) The basic training in regard to the items of works the way in which these items are to be performed and the tools to be used should be imparted initially and through occasional demonstration.

(e) The items of work which can be performed as a one-time operation at regular time intervals like asphalt patches, lopping branches, redoing the washed off bank etc. can best be done by moving the whole gang of labours together on the road rather than keeping one or two labours on isolated areas. While making the whole labour gang mobile, the supply of required materials and equipment need to be tailored to the needs to ensure that neither the man power nor the materials are wasted or the labours remain idle.

(f) If every labour clearly knows what he is to do and how much to do in his day; he will do that. The site supervisory staff should therefore develop quantity and quality standards for day's work of different items and bring them home to the labour. The system of daily work diaries of labours would be very useful to establish work standards.

(g) Rendering services like drinking water supply, rest sheds and prompt medical attendance in case of emergency can go a long way in not only improving the productivity but also in developing sense of belonging to the department.

(h) Pertinently, labour productivity is closely related to the efficiency and interest of immediate supervisory staff and therefore meaningful regular training of lower level supervisory staff is a pre-requisite of the process of improving labour productivity.

9. **Unit Quantities of Materials and Man Power for M&R Works**

Input requirement of material and man power for M&R Works solely depends on the condition of each road. The successful performance of M&R activities warrants detailed condition survey and cost estimates of each item of work and undertaking M&R works accordingly. The practice, currently in vogue in some P.W.D. divisions, to sanction detailed M&R estimates of each road well before the beginning of the fiscal year and carry out works accordingly during the year needs to be followed without exception. In absence of detailed condition inventory, the viable alternative is to assess M & R needs on the basis of average conditions prevailing on roads. The group, while keeping in mind the paraters outlined in para 5 held detailed discussions to quantity man-power and material requirement for each maintenance activity to arrive at M&R cost estimates per km. of road under varying traffic loads, climatic conditions, proce-zones and topography features. The summary of discussions and conclusions follow:

(i) Labour component of all ordinary repair activities is expected to be handled by regular departmental labour. The labour requirement for establishing a permanent gang system on each road was determined as shown in Table III in para 5(vii). As mentioned earlier in para 5(vi), the average labour wages would be Rs. 1100/- p.m. and accordingly the unit cost of labour is shown in Annexure-IV A to F & VA to F.

(ii) The quantities of materials required and their values as per the price zones for activities under ordinary repairs are shown in Annexure-IV & V, (A to F). The quantities are based on the average area of the surface necessary to be repaired in one km length.

(iii) The items of ordinary repairs which cannot be quantitied in a logical way have been treated on lumpsum basis keeping in view the traffic volumes and categories of roads as shown in Annexure-IV & V, (A to F).

(iv) On the basis of typical but detailed rate analysis furnished in Annexure-VI A to F different renewal treatments, the renewal costs for different price zones on the basis of life-cycle as shown in Table IV in para 6.2.1. are workd out for one km length of road of different categories and are shown in Annexure-IV & V, (A to F).

(v) The items of special repair works are not of uniform nature and cannot be covered under normal ordinary or renewal repair items. The quantification in regard to man-power and material; even on average basis, being not possible; the provisions on lumpsum basis keeping in view the traffic volumes & road categories without consideration of price-zones have been suggested in Annexure-IV & V, (A to F). The overall lumpsum amount made available to the PWD would be used for special needs of certain roads.

(vi) The monetary needs to restore flood damages would not only vary from place to place but may also vary from road to road. It is absolutely necessary to prepare detailed cost estimates for such damages. Such unforeseen requirement cannot be quantitied in real terms at early stages. As no funds would be available from normal M&R grants to repair such unanticipated damages; it is essential that suitable provisions be made well in time to help restore damages without loss of time. Lumpsum provision at a modest rate of 12½% of total M&R grant is suggested in Annexure-IV & V(A to F) to handle unforeseen situations, generally observed to accrue almost every year in some part of each State. The lumpsum amount made available may be suitably increased or decreased depending on the real needs assessed after the damages and may be allotted only where required.

(vii) The concept of premiums to be allowed over the normal M&R requirement is found to be very valid because of the fact that certain special situations and locations pose special maintenance problems like (a) heavy was out of bank and pavement in heavy rainfall area, (b) land slides, collapse of retaining and breast walls, chocking of road side and cross drainage openings etc. in hilly areas (c) undulations and breaking of pavements in black soil showing heavy swelling and shrinking of subgrade. The normal M&R grant per km. of road under average conditions, as is the case of most length of roads in the country, cannot accommodate such special requirement, necessary for only limited areas. It is also not possible in a reasonable way to quantify such special needs to identify specific road lengths where such needs exist. The viable alternative of giving some special allocation by way of premiums over the normal M&R grant on percentage basis is, therefore, adopted by the study group as detailed at the bottom of Annexure-IV & V (A to F).

10. **Maintenance and Repair Norms for Roads**

(i) The Study Group, after exhaustive discussion and careful consideration of (a) factors relevant to M&R requirement (b) close review of M&R practices in the States to which the group members belonged (c) the study of the earlier work done by committees, groups and in reports (d) the present day needs of rapidly growing traffic and (e) severe overall resource constraints, has worked out norms in respect of funds required per year per km for different categories of roads (except NHs) carrying different traffic volumes and located in different price zones. These updated norms are minimum "MUST" if the large capital assets are to be saved from deterioration beyond redemption and are to be used for the purpose they are built for. The details of norms of M&R costs for single lane roads are exhaustively given in Annexure-IV A to F and VA to F respectively for State Highways and other roads with the supporting rate analysis in Annexure-VI A to F. The cost summary is Annexure-III. The gist of M&R costs for lower and higher need roads in low price and high price zones is given in the Table V.

Table V
M&R costs per km including F D but excluding premiums

Category	Surface	Low price-zone		High price zone VI	
		Less than 150 CVD	More than 1500 CVD	Less than 150 CVD	More than 1500 CVD
SHs	B.T.	23187	39109	27601	47992
	W.B.M.	20267	31433	39878	62911
	Unsurfaced	8000	8000	8000	8000
			More than 450 CVD		More than 450 CVD
MDRS	B.T.	18247	26915	22286	33023
	W.B.M.	17803	23705	36461	47266
	Unsurfaced	6300	6300	6300	6300
			All Traffic densities		
Other Roads	B.T.	16953	-	20992	-
	W.B.M.	14855	-	30346	-
	Unsurfaced	6300	-	6300	-

(ii) It will be observed from the above Table V that the maintenance of W.B.M. roads in high price zone areas is not only very expensive but even higher than the B.T. roads because of heavy cost of large quantity of stone metal required. It will be, therefore, advisable and economical to convert such W.B.M. roads to B.T. surface at the earliest opportunity. Instead of adding renewal layers of WBM at regular time intervals, the practice would be to set apart grants exclusively for converting WBM roads to B.T. in stages.

(iii) Regarding earthen roads, it may be said that they are unlikely to carry heavy traffic volumes sheer because their condition does not attract traffic. Under the M&R requirement, these roads may need filling ruts and grading occasionally, say immediately after monsoon and couple of times during the year. Regular permanent labour gangs on such roads are rather unwarranted. Spreading some hard material in inadequate thickness in some lengths may give temporary relief but does not contribute to building the regular crust. Until the regular crust is built, these roads generally continue to be more or less in the same shape. With these considerations, the group decided to suggest reasonable lumpsum provisions for their maintenance without consideration of traffic volumes and price zones. While recognising the need for surfacing these roads, the group felt that they may better be included on priority as original works under the plan budget provisions rather than roads of new alignment. In addition, the allocation available under S.R. could be diverted to the extent possible to build crust on such roads in stages.

(iv) Some so-called earthen roads in some hilly areas are built with hard subgrade and top materials of higher C.B.R. values and are kept in proper shape. Such roads would not need building a sub base course with stone aggregates prior to building a base course for crust requirement by using graded stone aggregates. Such earthen roads are more or less equal to partially built WBM roads from all practical considerations and justify M&R grants at par with WBM surface to generate capital assets from recurring M&R expenditure. However, such hill roads would require specific identification after careful site study to qualify for M&R allocations at par with WBM roads.

(v) The norms worked out in details in Annexure IV A to F and VA to F relates to single lane SHS and MDRs and other roads. In view of needs of the M&R requirement for two lane. roads, as explained in details in para 5 (IX), the km costs of M&R for two lane (7.0 mt) pavement roads and for intermediate lane (5.5 mt) pavement roads would be respectively sixty percent (60%) and thirty percent (30%) more than those of single lane roads for similar price and traffic zones. These percentage increase will apply to the total M&R costs including flood damages.

(vi) The concept of premiums over normal M&R grants has been explained in details is para 9(vii), accordingly, the component of premiums admissible on certain roads would need to be computed on the basis of relevant percentage to arrive at total M&R normative requirement. The premium percentage would not apply to the component of flood damage repairs for computing total M&R costs.

(vii) The updated norms suggested in Annexure IV A to F and V A to F do not include the Tools and Plants requirement. It is suggested that separate allocation of 2 to 5% over the total M&R grant would be made available to help replace old and unserviceable machineries and also to procure some new additional items like hot mix plants. pavers etc.

(viii) The exercise was done, on the basis of data available with the members of the group, to assess M&R requirement of roads of the States they belonged, on the basis of updated norms. The exercise though preliminary, but fairly reliable, produced the picture given in Table VI.

TABLE VI
Summary of M&R requirement and actual allocation of 5 States

	Gujarat	Maharashtra	West Bengal	U.P.	H. Pradesh
S.H. length	9533	30543	4289	7974	3353
M.D.R. length	11443	37224	3976	17016	10950
ODR/VR length	39349	113005	13063	100050	–
Total length	60325	180772	21328	125040	14303
M&R requirement as per the norms suggested	Rs 132 crore	Rs 375 crore	Rs 60 crore	Rs 215 crore	Rs 42 crore
Actual Allocations of 88-89	Rs 63 crore	Rs 130 crore	Rs 25 crore	Rs 60 crore	Rs 20 crore

It will be observed from the Table VI that the actual allocations made available to these States are too inadequate even less than 50% of the normative requirement as per the up-dated norms suggested here on the minimum need basis. The fate of other States, it is afraid, may even be worse.

11. Summary of Conclusions and Recommendations:

(i) The maintenance and repair costs per km length of road as worked out in Annexure IV A to F and V A to F comprehensively reflect the most minimum needs at a price level of 87-88. Less than that would *tentamount* to arttracting serious deterioration of assets. The norms suggested would be revision to reflect the actual prevailing prices of labour and materials every year to work out total M&R requirement of each PWD Division and the State as a whole. The increase of 60% and 30% is necessary for two lane and intermediate lane roads respectively over the norms of single lane road.

(ii) The actual allocations made available reveal that they are even less than 50% of the minimum normative M&R requirement. The serious attention of the policy makers to improve the state of affairs is urgently warranted.

(iii) The suggested minimum maintenance norms are relevant only if the roads to be maintained are of required structural adequacy which is not so in many cases. Despite good maintenance practices, certain roads may show signs of neglect and failure because of inherent crust deficiency. The need to undertake pavement strengthening programmes wherever required is a prerequisite of good maintenance. In the situation of constraints of plan resources for road development, the strengthening works will warrant precedence over expansion if the real economic benefits to the community were to be kept in view.

(iv) Successful maintenance of roads while largely depending on allocation of funds as per norms also hinges on the scientific system approach which necessiates (a) inventory of the condition survey, (b) scheduling the overall programme as per priorities (c) monitoring the implementation and exercising controls (d) timely and equitable allocation of funds and (e) effective trained and meaningful supervision. The system approach, easy with the help of computers, is capable to reduce pressures in selection of works, ensure equitable distribution of funds on the basis of norms and help using the money where needed and most.

(v) The skill and productivity of labour and of immediate supervisory staff is an area critical to overall performance on the ground. Proper training, reporting system and surprise checking by higher level officers with a definite check list of items of maintenance can bring about slowly but steadily the sense of responsibility and accountability in the performance of those through whom most of the M&R funds are used. The norms of labour suggested should be followed to check the growing problem of indiscriminate and excessive recruitment of labour and to create better service conditions. The organisational changes, necessary to perform, effectively should deserve top priority.

(vi) While ensuring optimum use of available machinery, there is a dire need for replace old, absolute, and unserviceable pieces by modern and efficient ones like vibrating rollers hct mix plants, pavers, graders and stone crushers in the fleet. The need for trained machine operators may probably be more than machines in some States. In order that the tender rates and quality of work through contracting agencies are kept under check and that the emergent works are carried out promptly; carrying out some works (particularly B.T.) through departmental machines can be of great help.

(vii) The continuation of WBM roads as such is a high cost maintenance practice involving higher vehicle operating costs. There are enough of economic merits in converting them to B.T. may be, diversion of some funds from other employment oriented scheme would help tide over the perpetual resource constraint problem and change the scenario of the road system in the country. In addition, practice to reserve some amount exclusively for converting high traffic density WBM roads to B.T. surface would be very beneficial.

(viii) Side shoulders being an internal part of pavement for the purpose of traffic movement on single lane roads, the present situation leaves much to be desired. Converting soft shoulders to hard surface with full crust, while eliminating need for removal of part crust at the time of full widening, can help a great deal to the traffic flow. Special attention to shoulder, therefore, is an important maintenance need.

(ix) The life cycle of pavement or of renewal layer depends on the repeatitive axle loads. Increase in axle load beyond the design causes for more damage than expected. The reliable and regular traffic counts including weighment check, therefore assumes a key role in maintenance. It will be desirable to establish regular traffic count system at least upto MDR level in each division to help categorising roads for maintenance needs.

(x) Like the axle loads, the drainage is also a major cause contributing to road failures. The road surface and road side drainage, playing a pivotal role for stability, need special attention to ensure that there are no water pools. Proper and timely dressing of road structure and efficient disposal of water from road side gutters are the basic priority requirement of good maintenance.

(xi) Norms of suggested renewal treatments and their life cycles are the most minimum and if the funds do not permit meeting even such minimum needs, leave apart the question of clearing huge renewal backlog by additional allocation, then the conditions of the roads in the country under the unarrestable trend of traffic growth would not only bring discredit to the highway engineers and policy makers but also adversely affect the pace of development of all sectors, achieved after considerable efforts and investments, Better, therefore, earlier the issue of M&R needs of roads find due recognition by all concerned, particularly the Planning and Finance departments of the States.

(xii) The Study Group, while reiterating that allocations actually made available to PWDs of the States are for more inadequate compared to minimum needs, strongly feels that every States PWD should work out division-wise M&R needs on the basis of suggested norms and also the quantum of renewal back-log that has accumulated over the years on the basis of renewal life cycles recommended and pose the real problem to the highest authorities and seek their support in an effective manner before it becomes too late. To handle maintenance of roads by highway engineers. In the interest of maintenance and also to ensure that maximum possible could be achieved in minimum of funds, timely steps in planned manner, including organisational improvement, assume all the more importance.

(xiii) It is since Malhotra Committee of 1977 that this study group was appointed to go in details into the matters of M&R of roads, State Highways and other categories. As the traffic Volumes on roads have increased so much during the past decades and that the trend is continuing unabated; it is out of sheer need that review of maintenance practices, traffic engineering measures for safety and smooth flow, behaviour of pavements and cross drainage structures is warranted at closer time intervals, say every five year, at a national level to establish uniform practices and standards to meet travel needs of interstate travellers, increasing at a rapid rate.

The group feels that such exhaustive exercise would not have been possible without mutual support, interest, co-operation, detailed discussion and hard work of members of the group and the chairman, who has taken special pains for developing the frame work and writing the report.

In token of approval of the work done jointly by the Study Group, the signatures are placed below:

Sd/-
(A.J.Trivedi)
Chief Engineer (R&B)
& Joint Secretary,
Government of Gujarat,
& Chairman.

Sd/-
(M.V. Patil)
Superintending Engineer,
Thane Circle, Thane,
Maharashtra PWD,
& Member Secretary.

Sd/-
(I.C. Goel)
Superintending Engineer,
Office of Engineer-in Chief,
P.W.D., Shimla
& Member

Sd/-
(K.D. Aggarwal)
Superintending Engineer,
Projects, U.P. P.W.D.,
Lucknow
& Member.

Sd/-
(Gour Chatterjee)
Superintending Engineer,
Office of Engineer-in-Chief,
P.W.D., Calcutta
& Member.

Annexure-I

List of Members who attended the meeting of Study Group on updating norms for Maintenance of Roads.

Sr. No	Name of Member		No. of meetings attended
(1)	Shri A.J. Trivedi - Chief Engineer (R&B) & Joint Secretary to Govt of Gujarat, Roads & Bldgs Department, Sachivalaya, Gandhinagar,	Chairman	All
(2)	Shir M.V. Patil - Superintending Engineer, Thane, PWD Circle, Thane, Maharashtra.	Member Secratary,	All

(3)	Shri I.C. Goel - Superintending Engineer, Office of Engineer -in-Chief, PWD, Himachal Pradesh, Shimla	Member	All
(4)	Shri Gour Chatterji - Superintending Engineer, (N.H. D & P.C.) Govt. of West Bengal, PWD. Calcutta.	Member	All except the last.
(5)	Shri K.D. Aggarwal - Superintending Engineer, (Project), U.P. P.W.D., Headquarter, Lucknow.	Member	All except the last.
(6)	Shri Daniah - Executive Engineer, Traffic Engineering Cell Andhra Pradesh PWD, Hyderabad.	Member	1st meeting
(7)	Shri P.R. Rao - Executive Engineer (Norms), Ministry of Surface Transport, New Delhi.	Invitee	All
(8)	Shri R.D. Patel - Superintending Engineer, Sachivalaya, Roads & Buildings Deptt., Govt. of Gujarat.	Invitee	All

Annexure II

Summary of Price Zone Rates of materials & labour and costs of Renewal Treatments.

		ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V	ZONE VI
a)	Stone Chips	Rs 105.0 Cmt.	125.0 Cmt.	180.0 Cmt.	220.0 Cmt.	260.0 Cmt.	300.0 Cmt.
b)	Stone Metal	Rs. 60.0 Cmt.	90.0 Cmt.	110.0 Cmt.	150.0 Cmt.	190.0 Cmt.	230.0 Cmt.
c)	Sand	Rs. 20.0 Cmt.	25.0 Cmt.	35.0 Cmt.	45.0 Cmt.	60.0 Cmt.	70.0 Cmt.
d)	Labour of Hot mixing & Paver laying	Rs.70.0 M.T.	80.0 M.T.	90.0 M.T.	100.0 M.T.	100.0 M.T.	100.0 M.T.
e)	Bitumen	Rs 3500.0 M.T.	3500.0 M.T.	3500.0 M.T.	3500.0 M.T.	3500.0 M.T.	3500.0 M.T.
Treatments				Costs in Rupees per Kilometer			
(i)	20mm 5 D.C. (o.27 cmt/10 smt)	59950	63745	71280	77220	81510	85690
(ii)	20mm Carpet	48700	50870	57000	61450	65910	70360
(iii)	12 mm M.S.S. (0.18 cmt/10 smt)	40200	42800	47820	51720	54610	57650
(iv)	Metal Renewal (75 mm compacted)	37730	50160	58410	74910	91410	107910
(v)	Metal Renewal (60 mm compacted)	31400	41300	47900	61100	74300	87500
(vi)	Liquid sand Seal coat	23430	23650	23980	24310	24860	25245

Note: The zone prices are on average basis at which the material and labour can be procured on work site.

Annexure III

Summary of Maintenance Norms for Roads - Rs per km. per year

Categories	Price Zones of Chips and stone metal					
	ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V	ZONE VI
SHs						
Less than 150 CVD						
B.T.	22812	23406	24670	25654	26446	27227
W.B.M/gravel	19892	23359	25665	30278	34890	39503
150 to 450 CVD						
B.T.	26041	26314	27794	28948	29868	30776
W.B.M/gravel	20968	24469	26798	31456	36113	40771
450 to 1500 CVD						
B.T.	31767	32773	34852	36479	37759	38996
W.B.M./gravel	24140	28428	31250	36893	42532	48176
Over 1500 CVD						
B.T.	36875	38114	40676	42680	44243	45758
W.B.M./gravel	29199	34767	38469	45871	53274	60676
Unsurfaced	11269	12007	13637	14513	15264	16014
MDRs						
Less than 150 CVD						
B.T.	18060	18614	19787	20698	21897	22099
W.B.M./gravel	19813	20918	23111	27499	31886	36274
150 to 450 CVD						
B.T.	20375	23248	24670	25781	26660	27525
W.B.M./gravel	21073	21807	24046	28523	33001	37478
Over 450 CVD						
B.T.	23905	27159	28866	30115	31392	32648
W.B.M./gravel	21844	26012	28785	34326	39866	45407
Unsurfaced	9733	10466	11302	12973	13723	14474
CDRs/VRs/& Others: All traffic densities						
B.T.	15369	15922	17096	18007	20191	20892
W.B.M./gravel	14724	18009	20203	24591	30463	34851
Usurfaced	9733	10466	11302	12973	13723	14474

Noted:- Average prices in the Zones are in Annexure II

Annexure IV-A

Zone-wise Details of M&R Norms for One km. of NH/SH for Different Traffic Volumes

	Category	National Highway/State Highway Single – Lane								
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
Type of Surface		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	Ordinary Repairs									
i.)	Labour	3960	3960	3960	3960	3960	3960	3960	3960	2300
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	355
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.)	Patch Area	5.0%		5.5%		6%		7%		
a)	B.T.	2345		2565		2765		3220		800
	Surface -	(0.67T)		(0.73T)		(0.79T)		(0.92T)		(L.S.)
	Bitu.	492		542		590		689		
	Aggre.	(4.69 CM)		(5.16 CM)		(5.62 CM)		(6.56 CM)		
b)	W.B.M. Metal.		1200		1260		1335		1620	
			(20 CM)		(21 CM)		(22.25 CM)		(27.00 CM)	
	Murrum.		160		168		178		216	
			(5 CM)		(5.25 CM)		(5.56 CM)		(6.75 CM)	
iii.)	Arboriculture	125	125	125	125	125	125	125	125	125

iv.)	Side shoulders	500	500	500	500	500	500	600	600	
v.)	Store House & Shed	250	250	250	250	250	250	250	250	250
vi.)	C.D. Works & Bridges	250	250	250	250	250	250	250	250	250
vii.	Signs & km. Stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		8942	7465	9202	7633	9460	7578	10114	8041	4380
(2)	Periodical Renewals	MSS/6	MR/5	MSS/5	MR/5	SDC/5	MR/4	SDC/4	MR/3	
i.)	Premix/SDC MSS-B.T.	6716		8437		11990		14987		3859
ii.)	Metal Renewal-WBM		7550		7550		9435		12580	
iii.)	Liqi Sand S.coat	1953 (LSS/12)		1953 (LSS/12)		2343 (LSS/10)		2343 (LSS/10)		
(3)	Special Repairs	3000	3000	4000	4000	5000	5000	6000	6000	2000
(4)	F.D. Repairs 12.5% of total of (1) + (2)	2201	1877	2449	1885	2974	2127	3431	2578	1030
Total Rs.		22812	19892	26041	20968	317687	24140	36875	29199	11269

Premiums

1)	Rainfall	(a)	1500 to 3000 mm	: 15% of Ordinary repairs & renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black cotton soil & Desert areas			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure IV-B

Zone-wise details of M&R Norms for one km N.Hs/S.Hs (Single lane) for Different Traffic Volumes

Category		State Highway								
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
Type of Surface		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	Ordinary Repairs									
i)	Labour	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	2700 (L.S.)
	Mistry	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	548 (L.S.)
ii)	Patch Area	5.0%		5.5%		6%		7%		
a)	B.T. Surface	2345		2555		2765		3220		800
	Bitu.	(0.67T)		(0.73T)		(0.79T)		(0.92T)		(L.S.)
	Aggre.	586 (4.69CM)		645 (5.16CM)		702 (5.62CM)		820 (6.56CM)		
b)	W.B.M.-		1800		1890		2002		2430	
	Metal		(20CM)		(21CM)		(22.25CM)		(27.00CM)	
	Murrum		160 (5CM)		168 (5.25CM)		178 (5.65CM)		216 (6.75CM)	
iii.)	Arboriculture	125	125	125	125	125	125	125	125	125
iv)	Side Shoulder	500	500	500	500	500	500	600	600	-
v.)	Store House & shed	250	250	250	250	250	250	250	250	250
vi.)	C.D. Works & Bridges	250	250	250	250	250	250	250	250	250
viii.)	Signs & km. stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		9036	8065	9305	8163	9572	8285	10245	8851	4973
(2)	Periodical Renewals	MSS/6	MR/5	MSS/5	MR/5	SDC/5	MR/4	SDC/4	MR/5	
i)	Premix/SDC/MSS	7133		8560		12750		15936		
ii)	Metal Renewal		10032		10032		12540		16720	3922
iii)	Liqu. Sand S.coat	1970 (LSS/12)		1970 (LSS/12)		2365 (LSS/10)		2365 (LSS/10)		
(3)	Special Repairs	3000	3000	4000	4000	5000	5000	6000	6000	2000

(4)	F.D. Repairs 12.5% of Total of (1) + (2)	2267	2262	2479	2274	3086	2603	3568	3196	1112
Total Rs.		23406	23359	26314	24469	32773	28108	38114	34767	12007

Premiums:

1)	Rainfall	(a) 1500 to 3000 mm	:15% of ordinary repairs & renewals	
		(b) More than 3000 mm	:20%	-do-
2)	Hilly area	(a) Having No snow fall	:15%	-do-
		(b) Having snow fall	:30%	-do-
3)	Black Cotton soil & Desert Areas		:10%	-do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure IV C
Zone III

Zone-wise Details of M&R Norms for one km N.Hs/S.Hs (Single lane) for different Traffic Volumes

Category		State Highways								
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
Type of Surface		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	Ordinary Repairs									
i.)	Labour	3960	3960	3960	3960	3960	3960	3960	3960	3600
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	675
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	0.04)	(L.S.)
ii.)	Patch Area	5%		5.5%		6%		7%		
a)	B.T. Surface	345		2555		2765		3220		800
	-Bitu.	(0.67T)		(0.73T)		(0.79T)		(0.92T)		(L.S.)
	Aggre.	844		928		1011		1180		
		(4.69CM)		(5.16CM)		(5.62CM)		(6.56CM)		
b)	W.B.M.-		2200		2310		2448		2970	
	Metal		(20CM)		(21CM)		(22.25CM)		(27.00CM)	
	Murrum		160		168		178		216	
			(5CM)		(5.25CM)		(5.56CM)		(6.75CM)	
iii.)	Arboriculture	125	125	125	125	125	125	125	125	125
iv)	Side Shoulder	500	500	500	500	500	500	600	600	-
v.)	Store House & shed	250	250	250	250	250	250	250	250	250
vi.)	C.D. Works & Bridges	250	250	250	250	250	250	250	250	250
viii.)	Signs & km. stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		9294	8465	9588	8583	9881	8731	10605	9391	6000
(2)	Periodical Renewals	MSS/6	MR/5	MSS/5	MR/5	SDC/5	MR/4	SDC/4	MR/3	
(i)	Premix/SDC/MSS	7970		9564		14256		17820		
(ii)	Metal Renewal		11682		11682		14602		19470	
(iii)	Liqu. Sand	1998		1998		2398		2398		4344
	S.coat	(LSS/12)		(LSS/12)		(LSS/10)		(LSS/10)		
(3)	Special Repairs	3000	3000	4000	4000	5000	5000	6000	6000	2000
(4)	F.D. Repairs 12.5% of Total of (1) + (2)	2408	2518	2644	2533	3317	2917	3853	3608	1293
Total Rs.		24670	25665	27794	26798	34852	31250	40676	38469	13637

Premiums:

1)	Rainfall	(a) 1500 to 3000 mm	:15% of ordinary repairs & renewals	
		(b) More than 3000 mm	:20%	-do-
2)	Hilly area	(a) Having no snow fall	:15%	-do-
		(b) Having snow fall	:30%	-do-
3)	Black Cotton soil & Desert Areas		:10%	-do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure IV-D
Zone IV

Zone-wise details of M&R Norms for one km N.Hs/S.Hs (Single lane) for Different Traffic Volumes

Sr. No.	Category / Traffic Densities	State Highway: Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
	Type of Surface	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	Ordinary Repairs									
i)	Labour	3960	3960	3960	3960	3960	3960	3960	3960	4200
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	760
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii)	Patch Area	5%		5.5%		6%		7%		
a)	B.T. Surface	2345		2555		2765		3220		800
	-Bitu.	(0.67T)		(0.73T)		(22.25T)		(0.92T)		(L.S.)
	Aggre.	1032		1135		1236		1443		
		(4.69CM)		(5.16CM)		(5.62CM)		(6.56CM)		
b)	W.B.M.-		3000		3150		3338		4050	
	Metal		(20CM)		(21CM)		(22.25CM)		(27.00CM)	
	Murrum		160		168		178		216	
			(5CM)		(5.25CM)		(5.56CM)		(6.75CM)	
iii)	Arboriculture	125	125	125	125	125	125	125	125	125
iv)	Side Shoulder	500	500	500	500	500	500	600	600	-
v)	Store House & shed	250	250	250	250	250	250	250	250	250
vi)	C.D. Works & bridges	250	250	250	250	250	250	250	250	250
viii)	Signs & km. stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		9482	9265	9795	9423	10106	9621	10868	10471	6685
(2)	Periodical Renewals	MSS/6	MR/5	MSS/5	MR/5	SDC/5	MR/4	SDC/4	MR/3	
i)	Premix/SDC/MSS	8630		10356		15444		19305		
ii)	Metal Renewal		14982		14982		18728		24970	
iii)	Liqu. Sand	2025		2025		2431		2431		4438
	S.coat	(LSS/12)		(LSS/12)		(LSS/10)		(LSS/10)		
(3)	Special Repairs	3000	3000	4000	4000	5000	5000	6000	6000	2000
(4)	F.D. Repairs 12.5% of Total of (1) + (2)	2517	3031	2772	3051	3498	3544	4076	4430	1390
	Total Rs.	25654	30278	28948	31456	36470	36893	42680	45871	14513

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewal
		(b)	More than 3000 mm	:20% -do-
2)	Hilly area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Area			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure IV E
Zone V

Zone-wise Details of M&R Norms for one km N.Hs/S.Hs (Single lane) for Different Traffic Volumes

Sr. No.	Category / Traffic Densities	State Highway: Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
	Type of Surfce	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	Ordinary Repairs									
i.	Labour	3960	3960	3960	3960	3960	3960	3960	3960	4400
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(L.S.)

	Mistry	720	720	720	720	720	720	720	720	927
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
	ii. Patch Area	5%		5.5%		6%		7%		
a)	B.T. Surface									
	-Bitu.	2345		2555		2765		3220		800
		(0.67T)		(0.73T)		(0.79T)		(0.92T)		
	Aggre.	1219		1341		1462		1706		
		(4.69CM)		(5.16CM)		(5.62CM)		(6.56CM)		
b)	W.B.M.-		3800		3990		4227		5130	
	Metal		(20CM)		(21CM)		(22.25CM)		(27.00CM)	
	Murrum		160		168		178		216	
			(5CM)		(5.25CM)		(5.56CM)		(6.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	125
iv	Side Shoulder	500	500	500	500	500	500	600	600	-
v.	Store House & shed	250	250	250	250	250	250	250	250	250
vi.	C.D. Works & Bridges	250	250	250	250	250	250	250	250	250
viii.	Signs & km. stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		9669	10065	10001	10263	10332	10510	11131	11551	7052
(2)	**Periodical Renewals**									
		MSS/6	MR/5	MSS/5	MR/5	SDC/5	MR/4	SDC/4	MR/3	
i.	Premix/SDC/MSS	9101		10922		16301		20377		
ii.	Metal Renewal		18282		18282		22852		30470	
iii.	Liqu. Sand	2071		2071		2486		2486		4738
	S.coat	(LSS/12)		(LSS/12)		(LSS/10)		(LSS/10)		
(3)	Special Repairs	3000	3000	4000	4000	5000	5000	6000	6000	2000
(4)	F.D. Repairs 12.5% of									
	Total of (1) + (2)	2605	3543	2874	3568	3640	4170	4249	5253	1474
	Total Rs.	123446	34890	29868	36113	37759	42532	44243	53274	15264

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewal	
		(b)	More than 3000 mm	:20%	-do-
2)	Hilly area	(a)	Having no snow fall	:15%	-do-
		(b)	Having snow fall	:30%	-do-
3)	Black Cotton soil & Desert Areas			:10%	-do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure IV-F
Zone VI

Zone-wise details of M&R Norms for one Km N.Hs/S.Hs (single lane) for different traffic volumes

	Category	State Highway								
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		450 to 1500 CVD		Over 1500 CVD		Unsurfaced Road
Type of Surfce		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	5280	5280	5280	5280	5280	4600
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	1094
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	5.0%		5.5%		6%		7%		
a)	B.T. Surface	2345		2555		2765		3220		800
	-Bitu.	(0.67T)		(0.73T)		(0.79T)		(0.92T)		
	Aggre.	1407		1548		1686		1986		
		(4.69CM)		(5.16CM)		(5.62CM)		(6.56CM)		
b)	W.B.M.-		4600		4830		5118		6210	
	Metal		(20CM)		(21CM)		(22.25CM)		(27.00CM)	

	Murrum		160 (5CM)		168 (5.25CM)		178 (5.56CM)		216 (6.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	125
iv	Side Shoulder	500	500	500	500	500	500	600	600	-
v.	Store House & shed	250	250	250	250	250	250	250	250	250
vi.	C.D. Works & Bridges	250	250	250	250	250	250	250	250	250
vii.	Signs & km. stones	300	300	300	300	300	300	300	300	300
Total for O. Repairs		9857	10865	10208	11103	10556	11401	11393	12631	7419
(2)	**Periodical Renewals**	MSS/6	MR/5	MSS/5	MP/5	SDC/5	MR/4	SDC/4	MR/3	
i.	Premix/SDC/MSS	9575		11490		17138		21422		
ii.	Metal Renewal		21582		21582		26978		35970	5038
iii.	Liqu. Sand S. Coat	2103 (LSS/12)		2103 (LSS/12)		2525 (LSS/10)		2525 (LSS/10)		
(3)	Special Reapirs	3000	3000	4000	4000	5000	5000	6000	6000	2000
(4)	F.D. Repairs 12.5% of Total of (1) & (2)	2392	4056	2975	4086	3777	4797	4418	6075	1557
Total Rs.		27277	39503	30776	40771	38996	48176	45758	60676	16014

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewals
		(b)	More than 3000 mm	:20% do
2)	Hilly area	(a)	Having no snow fall	:15% do
		(b)	Having snow fall	:30% do
3)	Black Cotton soil & Desert Area			:10% do

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-A
Zone I

Zone-wise details of M&R Norms for one Km MDR/ODR/VR (single lane) for different traffic volumes

	Category	MDR		CDR/VR/ MDR/ODR/VR						
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		Over 450 CVD		All traffic Densities		Unsurfaced Road
Type of Surface		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labour	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	3960 (0.3)	2640 (0.2)	2640 (0.2)	2300 (L.S.)
	Mistry	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	720 (0.04)	355 (L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface -Bitu.	1856 (0.53T)		1925 (0.55T)		2345 (0.67T)		1855 (0.53T)		400 (L.S.)
	Aggre.	374 (3.75CM)		443 (4.22CM)		492 (4.69CM)		394 (3.75CM)		
b)	W.B.M.-Metal		900 (15CM)		1020 (17CM)		1200 (20CM)		900 (15CM)	
	Murrum		120 (3.75CM)		138 (4.25CM)		160 (5CM)		120 (3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100
iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
vii.	Signs & km. stones	200	200	200	200	200	150	100	100	100
Total for O. Repairs		8004	6775	8273	7061	8842	7315	6234	5005	3455
(2)	**Periodical Renewals**	MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	6716		8060		9740		6716		

ii.	Metal Renewal		7550		7550		9435		7550	3859
iii.	Liqu. Sand		1953		2343					
	S.coat		(LSS/12)		(LSS/10)					
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	6600	1500
(4)	F.D. Repairs 12.5% of									
	Total of (1) & (2)	1840	2035	2042	2119	2323	2094	1619	1569	914
Total Rs.		18060	19813	20375	21073	23905	21844	15369	14724	9733

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Area			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-B
Zone II

Zone-wise details of M&R Norms for one km MDR/ODR/VR (Single lane) for Different Traffic Volumes

	Category	MDR		ODR/VR/ MDR/ODR/VR						
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		Over 450 CVD		All traffic Densities		Unsurfaced Road
	Type of Surfce	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	3960	3960	3960	2640	2640	2700
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	548
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface	1855		1925		2345		1855		400
	-Bitu.	(0.53T)		(0.55T)		(0.67T)		(0.53T)		(L.S.)
	Aggre.	469		527		586		469		
		(3.75CM)		(4.22CM)		(4.69CM)		(3.75CM)		
	W.B.M.-Metal		1350		1530		1800		1350	
			(15CM)		(17CM)		(20CM)		(15CM)	
	Murrum		120		136		160		120	
			(3.75CM)		(4.25CM)		(5CM)		(3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100
iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
vii.	Signs & km. stones	200	200	200	200	200	150	100	100	100
Total Rs		8079	7225	8357	7571	8936	7915	6309	5455	4048
(2)	**Periodical Renewals**									
		MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	7133		8560		10174		7133		
ii.	Metal Renewal		10035		10035		12540		10020	3922
iii.	Liqu. Sand			1970		2365				
	S.coat			(LSS/12)		(LSS/10)				
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	600	1500
(4)	F.D. Repairs 12.5% of									
	Total of (1) + (2)	1902	2158	2361	2201	2684	2557	1680	1934	996
Total Rs.		18614	20918	23248	21807	27159	26012	15922	18009	10466

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Areas			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-C
Zone III

Zone-wise details of M&R Norms for one Km MDR/ODR/VR (single lane) for different traffic volumes

	Category	MDR				ODR/VR/MDR/ODR/VR				
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		Over 450 CVD		All traffic Densities		Un surfaced Road
Type of Surfce		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	3960	3960	3960	2640	2640	3600
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	675
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface	1855		1925		2345		1855		400
	-Bitu.	(.53T)		(.56T)		(.67T)		(.53T)		(L.S.)
	Aggre.	675		769		844		675		
		(3.75CM)		(4.22CM)		(4.69CM)		(3.75CM)		
	W.B.M.-Metal		1650		1870		2200		1650	
			(15CM)		(17CM)		(20CM)		(15CM)	
	Murrum		120		136		160		120	
			(3.75CM)		(4.25CM)		(5CM)		(3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100
iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
viii.	Signs & Km. stones	200	200	200	200	200	150	100	100	100
Total Rs		8285	7525	8589	7911	9194	8815	8175	5255	5075
(2)	**Periodical Renewals**	MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	7970		9564		11400		7970		
ii.	Metal Renewal		11685		11685		14605		11670	4344
iii.	Liqu. Sand			1998		2398				
	S.coat			(LSS/12)		(LSS/10)				
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	600	1500
(4)	F.D. Repairs 12.5% of Total of (1) + (2)	2032	2401	2519	2450	2874	2865	1811	2178	1177
Total Rs.		19787	23111	24670	24046	28866	28786	17096	20203	12096

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Areas			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-D
Zone IV

Zone-wise details of M&R Norms for one Km MDR/ODR/VR (single lane) for different traffic volumes

Sr. No.	Category / Traffic Densities	MDR: Less than 150 CVD		MDR: 150 to 450 CVD		ODR/VR/ MDR/ODR/VR: Over 450 CVD		ODR/VR/ MDR/ODR/VR: All traffic Densities		Unsurfaced Road
Type of Surfce		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	3960	3960	3960	2640	2640	4200
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	760
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface	1855		1925		2345		1855		400
	-Bitu.	(0.53T)		(0.55T)		(0.67T)		(0.53T)		
	Aggre.	825		928		1031		825		
		(3.75CM)		(4.22CM)		(4.69CM)		(3.75CM)		
	W.B.M.-Metal		2250		2550		3000		2250	
			(15CM)		(17CM)		(20CM)		(15CM)	
	Murrum		120		136		160		120	
			(3.75CM)		(4.25CM)		(5CM)		(3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100
iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
viii.	Signs & Km. stones	200	200	200	200	200	150	100	100	100
Total Rs		8435	8125	8758	8591	9381	9115	6665	6355	5760
(2)	**Periodical Renewals**	MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	8630		10356		12290		8630		
ii.	Metal Renewal		14985		14985		18730		14970	4438
iii.	Liqu. Sand			2025		2431				
	S.coat			(LSS/12)		(LSS/10)				
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	600	1500
(4)	F.D. Repairs 12.5% of Total of (1) + (2)	2133	2889	2642	2947	3013	3481	1912	2666	1275
Total Rs.		20698	27499	25781	28523	30115	34326	18007	24591	12973

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & Renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly Area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Area			:10% - o-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-E
Zone V

Zone-wise details of M&R Norms for one km MDR/ODR/VR (single lane) for different traffic volumes

Sr. No.	Category / Traffic Densities	MDR: Less than 150 CVD		MDR: 150 to 450 CVD		ODR/VR/ MDR/ODR/VR: Over 450 CVD		ODR/VR/ MDR/ODR/VR: All traffic Densities		Unsurfaced Road
Type of Surfce		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	3960	3960	3960	2640	2640	4400
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(L.S.)

	Mistry	720	720	720	720	720	720	720	720	927
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface	1855		1925		2345		1855		400
	-Bitu.	(0.53T)		(0.55T)		(0.67T)		(0.53T)		
	Aggre.	975		1097		1219		975		
		(3.75CM)		(4.22CM)		(4.69CM)		(3.75CM)		
	W.B.M.-Metal		2850		3230		2800		2850	
			(15CM)		(17CM)		(20CM)		(15CM)	
	Murrum		120		136		160		120	
			(3.75CM)		(4.25CM)		(5CM)		(3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100
iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
viii.	Signs & Km. stones	200	200	200	200	200	150	100	100	100
Total Rs		8585	8725	8927	9271	9569	9915	8135	8275	6127
(2)	**Periodical Renewals**	MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	9101		10922		13182		9101		
ii.	Metal Renewal		18285		18285		22855		18270	4738
iii.	Liqu. Sand			2071		2486				
	S.coat			(LSS/12)		(LSS/10)				
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	600	1500
(4)	F.D. Repairs 12.5% of Total of (1) & (2)	2211	3376	2740	3445	3155	4096	2155	3318	1358
Total Rs.		21397	31886	26660	33001	31392	39866	20191	30463	13723

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15% of ordinary repairs & Renewals
		(b)	More than 3000 mm	:20% -do-
2)	Hilly Area	(a)	Having no snow fall	:15% -do-
		(b)	Having snow fall	:30% -do-
3)	Black Cotton soil & Desert Areas			:10% -do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure V-E
Zone VI

Zone-wise details of M&R Norms for one km MDR/ODR/VR (single lane) for different traffic volumes

	Category	MDR				ODR/VR/ MDR/ODR/VR				
Sr. No.	Traffic Densities	Less than 150 CVD		150 to 450 CVD		Over 450 CVD		All traffic Densities		Unsurfaced Road
Type of Surfce		B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	B.T.	W.B.M.	
(1)	**Ordinary Repairs**									
i.	Labours	3960	3960	3960	3960	3960	3960	2640	2640	4600
		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(L.S.)
	Mistry	720	720	720	720	720	720	720	720	1094
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(L.S.)
ii.	Patch Area	4.0%		4.5%		5%		4%		
a)	B.T. Surface	1855		1925		2345		1855		400
	-Bitu.	(0.53T)		(0.55T)		(0.67T)		(0.53T)		
	Aggre.	1125		1266		1407		1125		
		(3.75CM)		(4.22CM)		(4.69CM)		(3.75CM)		
	W.B.M.-Metal		3450		3910		4600		3450	
			(15CM)		(17CM)		(20CM)		(15CM)	
	Murrum		120		136		160		120	
			(3.75CM)		(4.25CM)		(5CM)		(3.75CM)	
iii.	Arboriculture	125	125	125	125	125	125	125	125	100

iv	Side Shoulder	300	300	400	400	500	500	200	200	-
v.	Store House & shed	200	200	250	250	250	250	100	100	100
vi.	C.D. Works & Bridges	250	250	250	250	250	250	100	100	100
viii.	Signs & Km. stones	200	200	200	200	200	150	100	100	100
Total Rs		8735	9325	9096	9951	9757	10715	8285	8875	6494
(2)	**Periodical Renewals**									
		MSS/6	MR/5	MSS/5	MR/5	PC/5	MR/4	MSS/6	MR/5	
i.	Premix/SDC/MSS	9575		11490		14072		9575		
ii.	Metal Renewal		21585		21585		26980		21570	5038
iii.	Liqu. Sand			2103		2525				
	S.coat			(LSS/12)		(LSS/10)				
(3)	Special Reapirs	1500	1500	2000	2000	3000	3000	800	600	1500
(4)	F.D. Repairs 12.5% of Total of (1) & (2)	2289	3864	2836	3942	3294	3770	2232	3806	1442
Total Rs.		22099	36274	27525	37478	32648	45407	20892	34851	14474

Premiums:

1)	Rainfall	(a)	1500 to 3000 mm	:15%	of ordinary repairs & Renewals
		(b)	More than 3000 mm	:20%	-do-
2)	Hilly Area	(a)	Having no snow fall	:15%	-do-
		(b)	Having snow fall	:30%	-do-
3)	Black Cotton soil & Desert Area			:10%	-do-

Note: For two lane roads and intermediate lane roads the above rates of single lane should be multiplied by 1.6 and 1.3 respectively.

Annexure VI-A

Typical Rate Analysis for 20 mm Semi Dense Carpet

Item: Providing & laying 20 mm semi dense carpet 0.27 mt/10 Smt. using Asphalt for tack coat @ 5 kg/10 Smt & for mixing @ 5% of mix by hot mix plant and paver finiisher.
(Cost analysis for 1 km length having 3.75 mt. carriageway)

(A) **Measurements:** Weight of 0.66 Cmt. of mix material is equal to on Ton.

Total quantity of mix in one km= 1000 x 3.75 x 0.27/10 x 1/0.66 = 154.00 tons (I)

(B) Basic rates adopted in mixed material as under:

Rate of B.T. Chips = Rs. 105/Cmt

Rate of Asphalt = Rs. 3500/M.T.

Labour charges = Rs. 70/M.T.

(C) **Cost of aggregate in one ton of mix**

i. Wt. of Chips in 1 Ton of mix = 950 kg.

ii. Wt. of 0.66 Cmt. of chips = 1 Ton

Volume of 950 kg Chips = 0.66/1000 x 950 = 0.627 Cmt.

iii. Cost of Chips in one ton of mix = 0.627 x 105/Cmt = 65.83 (II)

(D) **Cost of Asphalt in one Ton of Mix**

i M.T. mix will cover area = 0.66 x 10/0.27 = 24.44 Smt.

ii. Asphalt required for tack coat @ 5 kg/10 Smt.= 24.44/1 x 5/10 = 12.22 kg

iii. Asphalt required for mixing at 5% of mix = 50.00 kg

iv. Total Asphlat required = (II) + (III) = 62.22 kg.

v. Cost of Asphalt = 62.22 x 3500/1000 = 217.77 (III)

(E) Labour charges for one ton of mix including fuel mixing and spreading with paver = 70.00/M.T.

(F) Total cost of 1 ton of mix = C + D + E =353.60 M.T.

(G) Cost of 20mm thick S.D.C. treatment is for one km single lane =154 x 353.60 = 54454.40

(H) Add 10% Contingency & Contractor's profit = Rs. 5450.00

(I) Total cost per km length is Rs. say 59950/- = Rs. 59904.40

Note: (1) The fines required and their cost are not separately shown in the analysis. However, fines may be used as per actual requirement and costs of aggreegates be worked out accordingly. There will be insignificant reduction on account of this in overall cost and therefore the fines do not appear in the analysis.

(2) The actual prices of material & labour substituted to arrive at the cost of the treatment for a particular road.

Annexure VI-B
Zone I

Typical Rate Analysis of 20 mm - Premix carpet

Item: Providing & laying 20 mm thick (0.27 Cmt/10 Smt) Premix carpet (Conventionally laid) using asphalt for tack coat at 5 kg/10 Smt. and for mixing @ 16 kg/10 Smt. (Approx 4%)

(A) **Measurement**

One km. Area = 1000.00 Mt. x 3.75 Mt = 3750 Smt

(B) **Qty. of materials in one km**

i. B.T. Chips 12 mm to 20 mm @ 0.15 Cmt/10 Smt. = 3750 x 0.15/10 = 56.25 Cmt. (I)

ii. B.T. Chips 6 mm 10 mm @ 0.12 Smt./10 Smt. = 3750 x 0.12/10 = 45.00 Cmt. (II)

= Total (I + II)

iii. Qty. of asphalt for tack coat @ 5 kg/10 Smt. = 3750 x 5.00/10 = 1875.00 kg

For mixing at 16 kg/10 Smt. = 3750 x 16/10 = 6000.00 kg

Total = 7875.00 kg.

(C) **Cost of 20 mm thick premix carpet for 1 km length with the Basic rates as under.**

Chips = Rs. 105/Cmt

Asphalt = Rs. 3500 M+T

Labour = Rs. 41/Cmt

Consolidation = Rs. 0.50/Smt.

I)	Cost of B.T. Chips 101.25 x 105.00		= Rs. 10,631.25
II)	Cost of Asphalt 7875 x 3.50		= Rs. 27,562.50
III)	Labour 101.25 x 41.00		= Rs. 4,151.25
IV)	Consolidation 3750 x 0.50		= Rs. 1,875.00
			= Rs. 44,220.00
(D)	Add 10% contingency & Contractors profit		= Rs. 4,422.00
		Total	= Rs. 48, 642.00
		Say	= Rs. 48,700.00

(E) Total cost per km. for 20 mm premix carpet is Rs. 48,700.00

Note (1) Actual prices be substituted for labour and materials to arrive at the real cost.

Annexure VI-C
Zone I

Typical Rate Analysis of Mix Seal Treatment

Item: Providing & laying 12 mm thick M.S.S. @ 0.18 Cmt/10 Smt. using Asphalt for tack coat @ 5 kg/10 Smt. and for mixing @ 4.5% to be done by hot mix plant & paver finisher.

(A) Measurements: Weight of 0.66 Cmt. of mix material is equal to one Ton.

Quantity of mix required in one km length = 1000/1 x 3.75/1 x 0.18/10 x 1/0.66 =102.27 MT.

(B) Basic Rates of Materials Chips = Rs. 105/Cmt.

Asphalt = Rs. 3500/M.T.

Labour Charges = Rs. 70/M.T.

(C) Cost of aggregates in one ton of mix

i. Wt. of Chips in 1 Ton of mix = 955 kg.

ii. Wt. of 0.66 Cmt. of Chips = 1 Ton

∴ Volume of 955 kg Chips = 0.66/1000 x 955 = 0.63 Cmt.

iii Cost of Chips in one M.T. of mix = 0.63 x 105/Cmt = 66.15 (I)

(D) Cost of Asphalt

i. 1 M.T. mix will cover area = 0.66 x 10/0.18 = 36.66 Smt.

ii. Asphalt required for tack coat @ 5 kg/10 Smt. = 36.66/1x5/10 = 18.33 kg.

iii. Asphalt required for mixing at 4.5% wt. of mix = 45.00 kg.

Total Asphalt = 63.33 kg.

Cost of Asphalt = 63.33 x 3500/1000 = 221.65 (II)

iv. Labour charges = 70.00/M.T. (III)

(E)	Cost of 1 Ton of mix material	I + III + III	
		66.15 + 221.65 + 70.00	= Rs. 357.80/M.T.

(F) Total cost of 12 mm thick M.S.S. treatment for 1 km length is::

Total Ton	Rate/Ton	
102.27	357.80	= Rs. 36,572.20
Add 10% Contingency & contractor's profit		= Rs. 3,657.22
		Rs. 40,251.42
Total cost per km is say		Rs. 40,300.00

Note (1) The treatment can be done in conventional manner if Hot Mix plant facility is not available.

(2) The actual prices of labour and material be substituted for real cost.

Annexure VI-D

Typical Rate Analysis of 75 mm Compacted Metal Renewal (MR)

Item: Providing & laying 75 mm thick (compacted) metal renewal including watering and consolidation.

(A) Measurement:

75 mm thick (compacted) will be equal to 100 mm loose.

Total area	- 1000 x 3.75	= 3750 Smt.
Material:		
i. Qty. of 40 mm to 63 mm H.B. Metal - Loose	3750 x 100/1000	= 375.00 Cmt.
ii. Qty. of Murrum (25% qty. of H.B. Metal)	= 375 x 25/100	= 93.75 Cmt.

(B) Cost of 75 mm thick compacted metal renewed

Materials:	Qty	Rate	Amount
i. Cost of Metal	375 x	Rs. 60/Cmt.	= Rs. 22500.00
ii. Cost of Murrum	93.75 x	Rs. 32/Cmt	= Rs. 3000.00
Labour			
iii. Cost of spreading the metal	= 375 x Rs. 7.75/Cmt. Rs. 2906		
iv. Cost of spreading the Murrum	= 93.75 x Rs. 4.60/Cmt. Rs. 431.50		
v. Cost of watering and consolidation	= 3750 x Rs. 0.95/Smt. Rs. 3562.50		
vi. Cost of picking the old metal before spreading new metal	= 3750 x Rs. 0.50/Smt Rs. 1875.00		
			Rs. 34275.00
		Say	Rs. 34300.00
Add 10% Contingency & Contractor's Profit			Rs. 3430.00
Total cost per km. per 3.75 mt. carriageway for 75 mm (Compacted) metal renewal			Rs. 37730.00

Note; The actual prices be substituted for labour and to arrive at a real cost for a particular road.

Annexure VI E
Zone I

Typical Rate Analysis for Liquid Sand Seal Coat.

Item: Providing & laying liquid sand seal coat with granular sand 0.09 Cmt./10 Smt. & asphalt for tack coat @ 15 kg/10 Smt.
(Cost analysis for 1 km length having 3.75 mt. carriageway)

(A) Measurement

Total Area	1000 x 3.75	= 3750 Smt.
Materials:		
i. Qty. of Granular sand @ 0.09 Cmt/10 Smt	0.09/10 x 3.75 x 1000	= 33.75 Cmt
ii. Qty. of Asphalt for tack coat @ 15 kg/10 Smt	15/10 x 3.75 x 100	= 5625 kg.

(B) Cost of liquid Sand Seal Coat

Material	Qty.	Rate	Amount
i. Cost of Granular sand	33.75 x	Rs. 20/Cmt	= Rs. 675.00
ii. Cost of Asphalt	5625 x	Rs. 3.5/kg	= Rs. 19687.50
Labour			
iii. Cost of spreading brooming respreading	33.75 x	Rs. 10/Cmt.	= Rs. 337.50
/iv. Cost of consolidation	3750 x	Rs. 0.15/Smt.	= Rs. 562.50
			Rs. 21262.50
Say.			Rs. 21300.00
Add 10% Contingency & Controlor's profit			Rs. 2130.00
Total cost per km. 3.75 mt. carriageway			Rs. 23430.00

Note: The actual prices be substituted for labour and materials to arrive at real cost of a particular road.